Ammonia Emissions State of the Science

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Biologically active, photochemically reactive, and radiatively active nitrogen compounds in the atmosphere, hydrosphere, and biosphere are collectively referred to as reactive nitrogen. Recent studies suggest that human activities accelerate the production of reactive nitrogen on a global scale. Increased nitrogen emissions may lead to environmental impacts including photochemical air pollution, reduced visibility, changes in biodiversity, and stratospheric ozone depletion. Ammonia (NH_3) is the most reduced and abundant form of reactive nitrogen in the atmosphere. In the last 50 years, emissions of NH_3 have significantly increased as a result of intensive agricultural management and greater livestock production. Globally, domestic animals are the largest source [$32x10^{12}$ g NH_3-N (ammonia-nitrogen) yr^{-1}] of atmospheric NH_3, comprising approximately 40% of natural and anthropogenic emissions combined. Additionally, synthetic fertilizers and agricultural crops together contribute $9x10^{12}$ g NH_3-N yr^{-1} (12% of total emissions). This paper presents a discussion of the ammonia emissions inventory based on emission factor, process based modeling, Carnegie-Mellon Model, and inverse modeling approaches. Ammonia emissions are compared and contrasted with all the criteria pollutants in the US and Europe. In addition, best management practices are explored as the scientific community attempts to maximize the beneficial use of reactive nitrogen while simultaneously minimizing negative environmental impacts.

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